Tips & Tricks

of the

USER GROUP

Masters

for the

SINCLAIR

ZX-81

OR TIMEX

TS1000

Revised Version 0.335

BY BILL J. HARMER, OTTAWA

© Copyright by Bill J. Harmer, Ottawa, Ont., Canada, December, 1996

Join the Hobby!

Introduction

To most of our readers purchasing a copy of the Tips and Tricks book for the Sinclair ZX-81, also sold under the name, Timex TS1000, the home computer itself will require no introduction. For those just casually picking this book off the shelf to glance in it, one might remark that the ZX-81/TS1000 was a popular hobby computer of the early 1980's and likely world's cheapest home computer ever made. Made in Scotland, the designer was English, Sir Clive Sinclair, knighted in large part for his work in introducing the Sinclair line of British computers, and it looks like an oversized black, plastic wedge-type doorstop. But it is so much more useful, a genuine electronic digital computer complete with operating system and BASIC programming language etched electrically inside, in ROM, But it was the ZX-81 that gave many computer experts their first taste of computer programming and/or hardware modification.

The computer was manufactured in the hundred thousand numbers and shipped all over the world, becoming a favourite in France and Portugal as well as in the Soviet Russian culture, in which home computerists were commonly referred to as 'Sinklerists.' In the USA, discount department stores sold it for as little as $35 at one time. Electronics students assembled them from kits. An oriental entrepreneur produced a clone of it, although not completely compatible for reasons of legal protection against copying it exactly. A number of magazines were started up to support and encourage users. Mailorder sales of programs and accessories flourished for some time in the the 1980's. Of course, its time has passed, but its glory days were memorable even in a time of flashy overnight success of computer entrepreneurs and their new, innovative designs.

There is a problem with the ZX-81/TS1000. It is often hard to get working and to make full use of its features. If the computer is old, the further question of whether or not this is due to damage also torments the experimenter attempting to start up an old ZX-81/TS1000. The answer in the 1980's was to join a user group, and then one could learn the tricks and ways of overcoming simple problems like trying to use an incompatible cassette recorder with it, or setting up a t.v. to work with it. Sometimes store personnel could help. Now however, the prospective user of the ZX-81/TS1000 lacks most of those resources, (a few user groups survive to this day, in 1996). To offer a partial substitute, this book, produced first in the late years of the ZX-81/TS1000's popularity, is offered. It is admittedly not foolproof and cannot anticipate every problem, but perhaps it is a good place to start.

Is the ZX-81/TS1000 Home Computer History?

Is the ZX-81/TS1000 home computer history? If so, then what of it; I mean is it not a good thing to celebrate the history of a hobby fad of the 1980's and the Sinclair ZX-81/Timex TS1000 home computer as the cheapest entry ticket to that hobby world at the time? Perhaps this book should actively seek to jerk the nostalgia reflex, in the hope that a generation brought up historyless will remember itself and its roots, or at least a small part of them. Surely, Dr. Johnson in saying that a person is never so innocently occupied as in making money, did not anticipate the era of hobbies, the hours of work, play and learning that occupied the freer, truer person, once the hours of making money were over for the day. Letting the free person out in the activity freely chosen of playing with a hobby may count as even more innocent an occupation of time as making money.

An introduction to this book today, 1996-1997, should introduce the ZX-81/TS1000 home computer, explaining that it was a really cheap but nonetheless genuine digital computer, and that it gave rise to many computer user groups around the world, of which the writer was a member of the Ottawa-Hull Timex/Sinclair User Group in the 1980's, (until if folded), and that this was part of an amazing mass movement, quite spontaneous and driven by fun and curiosity, towards self-education in the basic principles and use of old fashioned if not modern computers. The ZX-81/TS1000 was indeed closer to a mainframe of the 1960's especially one accessed interactively by video terminals, than any other type, (and certainly hard to compare favourably with the video graphics type of microcomputer popular in the 1990's).

The ZX-81/TS1000 was certainly a computer for the young, and no doubt some young people bought their ZX-81/TS1000 with their pocket money. It was also a computer for the middle-aged and even the older citizen, a local woman, a one-time teacher in her eighties, driven by curiosity to master it in order to understand what her grandchildren were talking about, when they talked about their careers in computers.

If we were out to write a strict history of the ZX-81/TS1000 we would likely be tempted to leave out all the technical aspects. To this writer this seems like trying to tell an isolated aboriginal tribe member about modern digital electronics. without mentioning what it is used for. Well, this book will try and fill in the blanks by offering a great deal of the technical lore, trivia and practical shortfalls and amazing strengths of the ZX-81/TS1000. It draws on the experiences of a decade or more of North American user group members, as seen and corresponded with, by the writer. It offers both a technical insight into the history of the home computer fad of the 1980's and a practical reference for those seeking to get their old specimens of ZX-81 or TS1000 actually working for a demonstration or display. If the ZX-81/TS1000 is history, then we should help the museums and commentators on the trends of the future and past patterns of computer economics, to keep their ZX-81/TS1000 skills alive and technical data accurately perceptive and fresh in the mind.

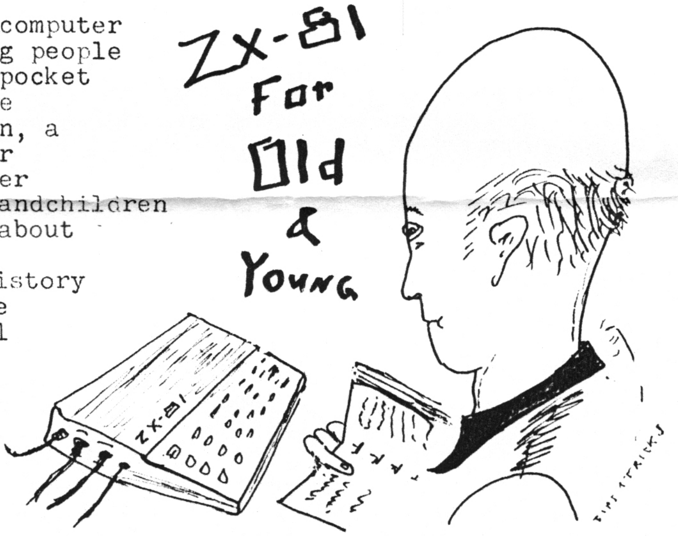

Illustration that the ZX-81/TS1000 is not just a toy for the young!

To the active ZX-81/TS1000 user, no such fancy introduction to the historical perspective is needed, although it is worth knowing that you may have a collector's item in your hands if not exactly an antique. So, here we go, on with the show. Let us see how to help the ZX-81/TS1000 do its stuff!

A Small Part of the Fascinating Story of Sir Clive Sinclair

Sir Clive Sinclair was not Sir Clive when our story of the ZX-81/TS1000 home computer begins. In fact, he was knighted by Queen Elizabeth II of Britain precisely for his contributions to Britain as a technological entrepreneur including his devising and marketing all around the world of the Sinclair ZX-81. The ZX-81 was the Timex TS1000, when the company that manufactured them in a watch-making plant in Scotland, Timex, saw so many come off their assembly line, made under contract for Sinclair, that they wanted a more proprietary equity investment in the little computer. The ZX-81 was marketed in France, was widely smuggled into the former Soviet Union, because it was unlikely to attract the attention of customs agents or when declared, cause them to take much interest in seizing it. Many were sold in Brazil and manufactured, at least for a while, (TS2048, etc.) in Portugal, ones similar to the North American TS2068. If imitation is the sincerest form of flattery, the ZX-81 also received that form of tribute from an oriental outfit that produced a sort of clone of it, with some differences, perhaps intended both to make it easier to manufacture and to add some features like sound, this clone not completely software-compatible and sold under various names including PC8300.

The ZX-81/TS1000, the subject of this book of tips and tricks, was not the first computer produced by Sir Clive, (before he became Sir Clive, but let us follow the groups and employ that titled name). The ZX-80 was quite similar as to hardware configuration, except that it used off-the-shelf TTL integrated circuits for the i/o interface, while the ZX-81/TS1000 replaced them by a MOSFET ULA chip, with a great saving in cost and simplification in assembly. The other difference was that the operating system and BASIC computer language in the ZX-80 was only a 4K byte version, one which only allowed for integer BASIC, while the later 8K version of the ZX-81/TS1000, allowed for a floating point (real number) BASIC which was capable of real calculations with fractional answers computed automatically. Other than a few other minor differences, the ZX-81/TS1000 was the same, although physically a little smaller, and most ZX-80 owners upgraded by adding new ROMs to bring their computer up to the level of the ZX-81/TS1000. Few ZX-80's were sold and they have become a collector's item now! A few Futura computers, actually the ZX-80 that had as operating system and computer language, the FORTH language built-in in ROM, were made but they never became popular, a tribute to the usefulness of the BASIC language and the way it crushed the competition in home computer languages then.

But the BASIC computer language dialect in the ZX-81/TS1000 became a problem for Sir Clive right at the beginning, as he had designed the ZX-81/TS1000 to win the contract for providing a low cost computer for the BBC computer course offered along with the Open University concept for upgrading the education of so many in Britain excluded from mass technological and intellectual education by the narrow elitism of Britain's publically funded educational system. The ZX-81 was rejected in favour of a competitor, the Acorn Atom, the latter having a dialect of BASIC that became known as BBC BASIC. The academics on the selection committee thought that certain instructions were needed to teach computer programming in structured languages, and were not available on the ZX-81/TS1000 BASIC, although in most people's opinions, the BASIC and BASIC-line programmer's editor is one of the easiest to learn BASIC programming from if not the all-time easiest, as many would further assert. In the event, a later computer, the Sinclair QL attempted to combine compatibility with conventional BASIC dialects with structured programming features like functions and procedures, and added networking and multi-user/tasking features of a most advanced type, making its SuperBASIC a language of interest to technical affectionados indeed.

But after the ZX-81/TS1000 came a number of Sinclair computers with more or less standard but enhanced BASIC dialects, the other Z-80 based computers following the rare ZX-80, and the mass produced and ubiquitous ZX-81/TS1000 of the 1980's home computer user/experimenter fad being in North America, the TS1500, the TS2068 and a few very, very rare US-tv standard Spectrum types. In Britain and the rest of Europe, the Spectrum models were sold, and upgraded from a relatively small RAM to 128K RAM and in the final models a Z-80H, high speed Z-80 microprocessor was used.

...The Story of Sir Clive Sinclair (Continued)

Around the middle of the Spectrum story of success in Britain, Sinclair ran short of cash, and the Sinclair name and company was sold to Amstrad, ensuring the survival of Spectrum computers for a while longer, although Amstrad moved into MS DOS computers, from CP/M computers, shortly after. Sir Clive went on to produce the Z-88 a light-weight notebook computer with CMOS Z-80, LCD screen and that old nemesis, BBC BASIC in ROM. It had about as much success as most notebook computers although it was a great deal more advanced in one design concept behind it, the use of mass eprom rather than disk storage— eprom-containing cartridges sold for the Z-88.

There is hardly space left to mention in a short piece like this, Sir Clive's life story as a technological entrepreneur, starting writing do-it-yourself electronics construction articles for hobby magazine publication, producing kits for miniature hi-fi amplifiers, small screen t.v.'s, pocket calculators and digital watches, until after his computer period just mentioned, trying to produce supercomputer chips with wafer-scale integration. In between, he marketed an electric car but found that the transportation infra-structure was not ready to cope with such purely personal (one and two-person) vehicles safely.

In short, the ZX-81/TS1000 was not just another mass market computer or toy like most of the others of the 1980's, but part of an on-going attempt to innovate in the most technical world of computer concepts, an attempt made by an adventurous and multi-faceted serious thinker and entrepreneur, Sir Clive Sinclair, a genius poorly understood (and modestly rewarded) in his own time. But there are many who did appreciate his work, and will be forever grateful for his ZX-81/TS1000. I am!

The Reincarnation of the Sinclair ZX-81/TS1000 In the Software Dimension

For those who once owned a ZX-81/TS1000 or those who never owned one, the first experiences of using one can substantially be simulated with the new software emulators of the ZX-81/TS1000, made to run on certain of the faster IBM PC compatibles. Indeed, not only the ZX-81/TS1000, but the British Spectrum and the Sinclair QL have been also put into the IBM PC/AT box, via software emulators, and a ZX-81/TS1000 emulator has been made for the Sinclair QL also. These are of course advertised in TS user group publications, or have been in 1994, and are said to work. So there is more than one way to evaluate the experience of ZX-81/TS1000 computer use if you are an historian of technical things, or simply curious. Of course you would need some extra hardware to load old programs saved on cassette onto disk, and this is generally not a part of the emulator package, but the emulators include the original BASIC dialect of the ZX-81/TS1000 in the case of that emulator and the Spectrum, in the case of that emulator. Some furthermore are not available for any commercial use, due to the terms of releasing that software for use in the emulators.

User Groups, Suppliers and Other Activities (As of Dec., 1996)

Timex-Sinclair North American User Group, (T/SNUG), produces a newsletter and takes out of town memberships.

What Kind of Computer Is The Sinclair ZX-81/TimexTS1000?

These days, the Sinclair ZX-81 which also goes under the name, the Timex TS1000, is a collector's item. It is not exactly a rare item, not as rare as the ZX-80 by Sinclair which preceded it, but ZX-81s kept operating as a hobby or in collections are certainly not often seen or talked about.

as this is written, there are hobby groups that have an often far-flung membership, that cover the ZX-81 Timex TS2068 and in some cases, the Sinclair QL, (quite a different machine, based as it is on the 68008 microprocessor and an exotic dialect of BASIC called SuperBASIC). These offer news, advice and sources of documenatation of what can be done by the hobbyist who owns a ZX-81 or TS1000. There are some clones of the ZX-81, mainly the PC8300, although it is not completely compatible with the ZX-81/TS1000, and there is the TS1500, a ZX-81/TS1000 with some improvements including a few mostly with the BASIC dialect in ROM, that make it not completely compatible with the ZX-81/TS1000. Still further off the beaten track are the few Futura FORTH language-based versions of what is essentially, inside, a ZX-81, although of course without BASIC and all the other goodies that make the ZX-81 and TS1000 compatibile with each other.

But do not be fooled by the tiny appearance of the ZX-81/TS1000 or its modest original selling price, around $35-100, depending on where purchased new, an extraordinarily low price for a home computer today as yesterday in the computer market. Today, buying a working ZX-81/TS1000 may be much harder and more expensive as time goes on, but it should be obvious that the ZX-81/TS1000 was made to be a mass market, bargain basement experimenter's toy. So many computer experts cut their teeth on a ZX-81/TS1000 it would be hard to know them all, but if you ask a, say, born-in-the-late-1950's-to-1960's-person who has made a career of the harder parts of computing if he or she knows what a ZX-81/TS1000 is, chances are you will get a favourable response. Many took their first steps in programming on these little black wedges, and a few actually assembled them from kits.

The Sinclair ZX-81 or Timex 1000, are real computers. They are micro computers, since they use a microprocessor for their main logic and arithmetic as well as functional control circuitry, that is, a single microprocessor integrated circuit on one chip, in fact the popular Z-80 by Zilog designers. The Zilog Z-80 is basically a souped-up version of the Intel 8080 but different enough to be a separate entity. It was also the first VLSI microprocessor and one planned for the Apple computer, but not used because it was too high in price. In this book a diagram of the internal functions of this Z-80 as used in the ZX-81/TS1000, is given, (page). The ZX-81/TS1000 allows programming in machine language, but one must say, with the software tools available only with difficulty, (and considerable frustration). There have been books written on machine language programming of the ZX-81/TS1000 and the reader should know that you need both books on the ZX-81/TS1000 machine language programming and on the Z-80 instruction set and programming as well, to really succeed. (This book concentrates on the use of the ZX-81/TS1000 in BASIC programming mode only).

THe ZX-81/TS1000 is not an ASCII character code computer, using instead its own unique character code. Accessories are available in some cases to allow the ZX-81/TS1000 to be used with other than Sinclair compatible peripherals, and of course, this requires some ingenuity in programming and adaptation. In this book we will assume that the user is using only Sinclair accessories and has accepted that the ZX-81/TS1000 is inputing or outputing only in the unique ZX-81/TS1000 character code. That is how it was done in the old days and it is too complicating to try and guess what ASCII devices might be hooked up to it not to mention the resulting compatibility problems that might surface.

So, here is to old-fashioned computer experimenting on the TS1000 or ZX-81. It was the road hundreds and perhaps thousands of hobbyists took to programming literacy, and to understanding the modern computer era, whether pre-teen or in their eigthies, something this writer can vouche for personally.

It has always been the case that computers have been associated with one or another of their evolving uses. Although home microcomputers have found many uses, one sees the major one for the Sinclair ZX-81/Timex TS1000 computers was that of providing a low cost, convenient (home) access to experimentation with computers, of testing out programming ideas and then watching them pass or fail that test running on real computer. Whether it is to test a programming idea in BASIC with a few lines of program entered from the keyboard, or to do a mathematical calculation when you do not have a programmable calculator, the ready availability of your ZX computer saved that trip across town or that late night spent after-hours, somewhere else than where you want to relax. And it had BASIC to work in the easiest language. Tons of people bought this $35 computer in the mid-1980's, and some today, when they may turn up at garage sales, even cheaper. Some mathematics textbooks even put in their back section, some routines in the BASIC programming language that a home computer with as standard a BASIC dialect as the ZX-81/TS1000 is likely to accept. These recipes brought dry math to life, usefully too. A library, public or school, is likely to have more of such recipes for doing anything from statistics to physics calculations, along with a few simple games, and most universally compatible with most computer types being the guessing games, where a word or letter or number is the target of the player.

It is true that not everything involving computer science can be taught on a small home computer like the ZX-81/TS1000, but since there is more to learn than anyone other than a genius can learn in many years, even a simple computer offers years of instruction and self-learning, if guided appropriately. There are for example, some simple concepts of computer science that the ZX-81/TS1000 can be used to demonstrate and even innovate with, for example, the sorting and searching algorithms and their variations. Of course, simple database programs can be written progressively, with search and sort routines added as well as entry edit, insert and delete routines. The building blocks of a file of all the members of a club, the record for each member and the field for the member's name, the field for the member's telephone number, and the field for dues paid, all such concepts of databases can be easily seen even in such a simple database. And it is interesting to write your own database and explore these features as you go along, rather than merely reading about them in a book or trying to glimpse them in a commercial database, where the beginner can only see the one-tenth of such data structures visible without advanced hacking skills, (as is possible with BASIC programs).

The ZX-81/TS1000 is easily damaged in some ways, the membrane keyboards wear out and the cassette interface transistors inside the irreplacable ULA silicon chip get zapped easily. But the keyboard is often not completely ruined, and will work enough in most cases to enter a few lines a session, and at any rate is completely repairable by fitting a proper accessory keyboard with movable keys. Even a ZX-81/TS1000 with the ULA chip ruined so that cassette saves and loads can no longer be made, can be used by just entering in short programs, writing them down on paper by hand, to save them for future reference. The full repair involves a computer with a fresh ULA or a disk drive, with a special ZX-81/TS1000 disk interface pcboard, like those of Oliger.

Another use favouring the ZX-81/TS1000 instead of any other type of computer, was also due to its low cost: its disposability. It justified use of the ZX-81/TS1000 for hardware experimentation. Due to the simplicity of design and the availability or assemblers and other debugging tools, the ZX-81/TS1000 was often used by electronics students. They made burglar alarms and interfaces, serial or parallel type with these computers. They added larger memories, sound and other features. They hooked them to low cost eprom programmers, and copied eproms filled with their own machine code software. In fact, in the computerized controller role, the ZX-81/TS1000 preceded many more expensive microcontroller units in getting costs down, and were even used in industry to control machinery, etc., at one time. A lot of these hardware hacker projects were published in magazines like Radio-Electronics and Popular Electronics, in the early 1980's. A number of small paperback books also offered plans and instructions for such hardware experments. It is hard today when computers are so complex to really get inside a computer and understand by trial and error and detailed reading, what happens when the software puts its invisible hands on the hardware levers and buttons buried deep inside the electronics of a computer. Many got a chance with the relatively simple, ZX-81/TS1000 to do exactly that, gaining a unique education.